

## SPREAD SPECTRUM RADIO COMMUNICATION SYSTEM

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to a mobile communication system such as a mobile telephone system, a cordless telephone system, a radio LAN system, and more particularly to a system to which a spread spectrum radio communication system is applied.

#### 2. Description of the Related Art

In recent years, attention has been paid to a spread spectrum radio communication system, which is strong against interference and disturbance, as one of communication systems applied to a mobile communication system.

The spread spectrum is used to realize a code division multiple access (CDMA) system. According to the CDMA system, in a transmitter apparatus, digitized voice data or image data are modulated by a digital modulation system such as a PSK or an FSK modulation system. Thereafter, modulated transmission data is converted to a base band signal of a wide range by use of a spread code such as a pseudorandom noise code (PN code), and thereafter, up-converted to a signal of a radio channel frequency to be transmitted. On the other hand, in a receiver apparatus, a received radio frequency signal is down-converted to an intermediate frequency signal or a base band frequency signal. Then, a reverse spread is carried out by use of the same code as the PN code used in the transmitter apparatus. Thereafter, the signal is digitally demodulated by the digital system such as the PSK or FSK demodulation system to reproduce received data.

In this kind of system, a RAKE receiver is used as one measure against fading. The RAKE receiver collects signals spreading in time sequence to provide diversity, and the following two structures are known well.

One structure will be explained as follows.

More specifically, a transversal filter with taps is connected to an output of a matched filter. Then, a weighting of a tap coefficient is changed, so that pulse strings outputted from the matched filter are added to provide a multi path synthesis.

The other structure will be explained as follows.

More specifically, a plurality of finger circuits comprising a timing tracking loop and a data demodulation section are provided. Then, these finger circuits are independently operated, so that the multi path synthesis can be provided.

However, in an actual mobile communication, a multi path of 10 nsec to 100 nsec exists indoors. In order to synthesize the multi path signals in the CDMA system, a chip rate of the PN code must be set to be high, such as 10 MHz to 100 MHz. Due to this, in the RAKE receiver, there are needed a high speed clock in accordance with the high chip rate, and a wide frequency band. Therefore, in the present state, no useful measures are taken in order to synthesize the multi path signals of 10 nsec to 100 nsec. Moreover, in the conventional RAKE receiver, since the chip rate is generally set to about 2 MHz, such a receiver is not useful in practical use.

Furthermore, in the above-explained RAKE receiver using the transversal filter with taps, the tap coefficient of the transversal filter with taps must be a suitable value so as to add and synthesize the output pulses of the matched filter.

Conventionally, in order to set the taps coefficient, there is proposed a system in which a sounding signal for mea-

suring is inserted to a communication signal to be transmitted in the transmission side. However, this system is not useful since a reduction of a communication efficiency and complication of a communication protocol are caused.

Also, there is proposed a system in which numerical calculations are performed by use of a learning identification method, and a least squares method, or a Kalman-filter-algorithm to obtain the tap coefficient. However, if a calculation processing section is provided in the RAKE receiver to perform these numerical calculations, the structure of the RAKE receiver is complicated and enlarged, and power consumption is increased. They are extremely unfavorable problems in the mobile radio apparatus, which aims at miniaturizing and lightening the apparatus and reducing power consumption as the most important subject.

### SUMMARY OF THE INVENTION

A first object of the present invention is to provide a spread spectrum radio communication system in which complicated numerical calculations in the transmission of a sounding signal and a mobile station are not required, whereby improvement of a communication efficiency, a miniaturization of the size of an apparatus, reduction of the weight of the apparatus, and low power consumption can be obtained.

A second object of the present invention is to provide a spread spectrum radio communication system and its radio communication apparatus in which a plurality of received transmission signals having a phase difference can be synthesized without providing a signal search caused by a phase variation of a spread signal in a mobile station, whereby signal synthesizing and reproducing means of the mobile station can be efficiently used to reduce fading and unfavorable influence of interference.

In order to attain the first object, weighting data generating means and weighting data transmitting means are provided in a base station. Then, weighting data to be provided to weighting and synthesizing means of a signal receiving and reproducing circuit formed in a mobile station is obtained by weighting data generating means in accordance with the characteristic of a radio transmission line between the base station and the mobile station, and obtained weighting data is notified to the mobile station by weighting data transmitting means. On the other hand, in the mobile station, weighting data receiving means and weighting data receiving and setting means are provided. Then, weighting data notified from the base station is received by the weighting data receiving means, received weighting data is set to the weighting and synthesizing means, and the synthesis operation of the transmission signal is performed by the signal receiving and reproducing circuit in accordance with weighting data.

As a result, according to the first invention, in the base station, weighting data to be provided to the signal receiving and reproducing circuit formed in the mobile station is generated based on the characteristic of the radio transmission line between the base station and the mobile station, and weighting data is transmitted to the mobile station to be set to the weighting and synthesizing means. Due to this, it is not needed that the sounding signal be transmitted to the mobile station from the base station in order to set weighting data to the weighting and synthesizing means. Moreover, it is unnecessary to carry out a complicated calculation processing in order to calculate weighting data in the mobile station. Therefore, the communication efficiency, miniaturization and reduction of the weight of the mobile station, and reduction of consumption power can be improved.